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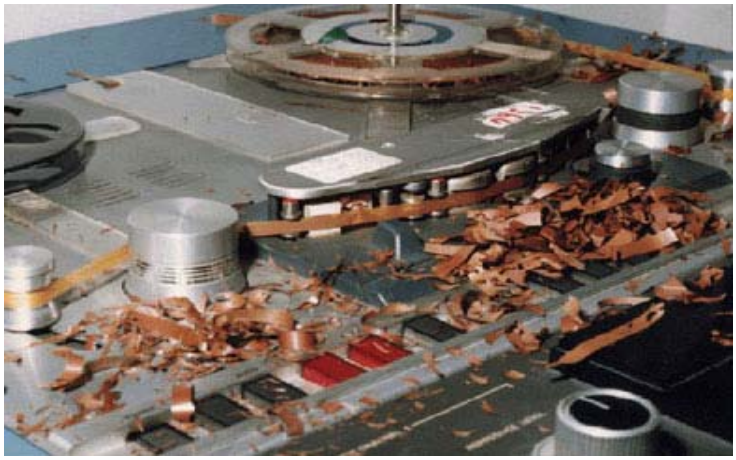
Aug 1, 2005 Video Archivist Meeting at NLM
Some Additional Points for a Video/Archival Technical Audience

The long-term preservation of video and multimedia assets appears increasingly to demand a digital form, but aspects of that form remain elusive and contentious. The introductory talk provides some perspectives of this from three of the NLM meeting conveners.

From the NLM Introduction

Paul Theerman, Head of Images and Archives in the History of Medicine Division, first surveys the scope of NLM's large historic film and video collection, as well as NLM's on-going collaborations with other NIH groups to capture and preserve "history in the making", scientific presentations on the NIH campus. Videotape originals are still chiefly analog, as are duplication copies (Betacam SP) and use copies (VHS). But NLM is on the cusp of moving to digital video archiving, motivating this conference.



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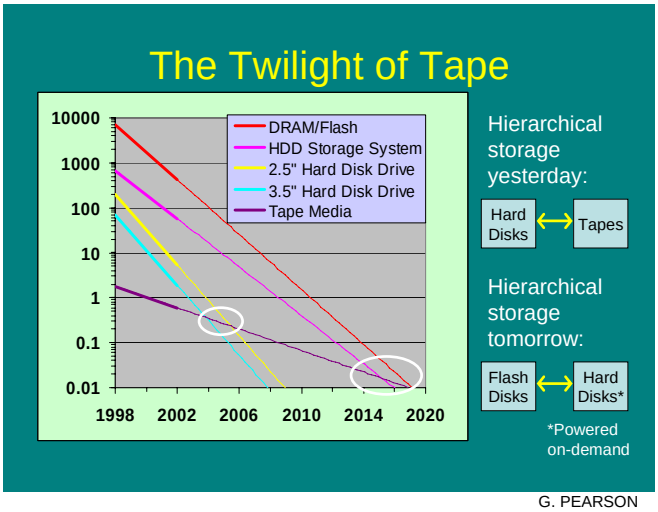
An Example of Media Deterioration. The magnetic oxide of this open reel audio tape has separated from its substrate.

Preservation Librarian Walter Cybulski then highlights the goals of preservation: content selection, mitigation against risks, and extending the useful life of content. The risk of media deterioration (shown at left) can be mitigated by climate controlled storage. Extending the life of content, in the face of equipment obsolescence (e.g., all analog videotape formats now except VHS/S-VHS), involves migration to new media forms.

Finally, software developer Glenn Pearson discusses digital video, beginning with the observation that migration as a preservation strategy continues in the digital domain, and can still incur generational losses if using lossy rather than mathematically lossless codecs. The latter include ones based on JPEG 2000 (JP2) lossless and MPEG4/AVC lossless.

The talk turns to how the economics of digital storage is rapidly favoring disk over tape (at right). This is as apt to video archives as any other data store.

Creating digital preservation masters from film is considered, with three format types (and various bit depths): source, digital intermediate, and Digital Cinema theatrical distribution. For now, this is financially out of reach for most non-Hollywood archives, suggesting a near-term focus on digitizing analog tape, not film. Even so, many questions remain.



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Digital Storage Costs. Extrapolating dollars per gigabyte, a bit on-disk (ignoring system costs) is getting cheaper than a bit on-tape [left circle]. With system costs (CPU, cache, RAID controller, frame, power supply), the crossover [right circle] is later, but other factors, like convenience, may drive a move to disk sooner.

As indicated, the economics of digital mastering can look quite different for film versus video. For video, the economics of broadcast distribution and preservation storage are likewise much different, as discussed next.

From the Talk by PBS's Jim Kutzner

PBS does a bit of production and post-production, but is chiefly concerned with distribution. It distributes 10,000 hours of unique programming per year to its 170 broadcast station members. Its latest standard-definition workflow is:

- Ingest incoming video tape;
- Save as IMX-50 (also called D-10 format) within MXF. This is 50 Mbps plus associated audio;
- Convert to a reduced bit-rate (lossy MPEG-2 at 8 Mbps plus associated audio) for real-time delivery via satellite to stations. Next year, PBS will also deliver files, compressed at that same bit-rate, at faster or slower than real-time;
- Stations then broadcast somewhere in the 2-8 Mbps range, generally 3-4Mbps.

This hierarchy (and its high-definition counterpart) affordably targets what the viewer will see. PBS must balance quality and cost. Regrettably, "it's prohibitive to exchange data with lossless compression." (Afterwards, Kutzner explains that is due to the costs, decreasing but slowly, of real-time satellite delivery. Such costs would be much greater for higher bit-rate formats, like the virtually lossless D-10 or mathematically lossless ones. And there's no point in distributing significantly higher quality than can be delivered to the viewer. Thus, lossless compression has its use in high-end production and preservation, not in distribution.)

The talk concludes by highlighting the on-going National Digital Information Infrastructure and Preservation Program (NDIIPP), which is much concerned with addressing important preservation questions upstream in the production process.

The deliberations of NDIIPP and standards bodies provides some of the channels through which the needs of archivists can be expressed, and ultimately addressed by solution providers, as suggested next.

From the Group's Discussion – Some Directions to Proceed

The afternoon's discussion was wide-ranging but regrettably time-limited. Absorption and structuring of the main highlights is underway, but some points are clear. The preservation of essence provided as analog video tape is the pressing problem for many archivists, more so than film. Thus, for many participants, the most salient use case at the moment is "archiving of material available in analog tape form", which is distinct from both production and distribution uses. The migration from analog to digital continues the ongoing process of preservation-by-migration. What are needed now are strategies for the timeframe and formats for this migration to first-digital-format.

This use case could be further split based on quality of the original, high (e.g., BetaCam SP) or low (e.g., VHS). One point of view is that low-quality originals do not justify the expense of digitizing into highest-quality digital form. But plummeting storage cost impacts this.

Several sets of metrics for preservation programs were discussed, useful in considering file formats. For instance, the Library of Congress is evaluating file formats on seven sustainability factors (see www.digitalpreservation.gov/formats/sustain/sustain.shtml) as well as those of quality and functionality.

One of the sustainability factors, adoption, was seen as a particular problem for Motion JPEG 2000 (MJ2), and perhaps lossless codecs in general. Government agencies and their requirements could serve as market makers, promoting the widespread provisioning of lossless compression in editors, browsers, and servers. This typically would take the form of QuickTime plug-ins on the Mac platform, DirectX codecs in Windows, and command-line programs in a transcoding workflow, as well as hardware solutions.

Within file formats making use of the JP2 codec, suggested improvements to standards (that might improve both adoption and interoperability, another sustainability factor) include:

- Defining an embedment of MJ2 within Material eXchange Format (MXF).
- Defining a use case (perhaps in the MPEG-A formalism) for lossless JP2 frames in MXF, analogous to Digital Cinema's lossy JP2 in MXF.
- Completing standards work on storing broadcast wav audio (AES/BWF) in MXF, plus define a use case and remove barriers for conversion of AES/BWF audio to/from native MJ2 audio.

Among desirable additions to the MJ2 standard itself would be ways to embed timecodes, text streams, and MPEG-7 metadata streams, to facilitate close captioning and per-scene metadata.

Such improvements can be pursued through the work of NDIIPP, the International Standards Organization (ISO), and the Society of Motion Picture and Television Engineers (SMPTE).

Coupled with algorithmic and evaluative research, and vigorous commercialization, the digital future for highest-quality video preservation can arrive.

A Few Take-Away Messages

- There is no future for analog videotape.
- For video archiving, digital videotape is having its moment now, but the transition has begun to on-disk archiving, a transition likely in high gear within five years and largely done within ten.
- The norm now for video archiving is one of a number of lossy compression and subsampling formats (e.g., on tape). A move to lossless-compression or uncompressed archiving will soon be affordable, in the same timeframe as the move to disk. But roadblocks must be overcome.
- A similar transition is underway for the higher resolutions and bit depths associated with digital cinema, but in the near term at a price point beyond what cultural institutions can afford as a means of film-originated preservation.
- Midwifery by archivists and their technological allies will help deliver digital formats matched to long-term preservation needs.